FRDA Report 167

Silviculture Decision Models: Summary of a Workshop

Cindy Pearce, R.P.F.

March 1991

Held November 7 and 8, 1990
in
Vancouver, British Columbia

Jointly sponsored by Forestry Canada, Pacific Forestry Centre and
the Forest Management Department of the Faculty of Forestry, University of British Columbia

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Dr. Glenn Manning, Chief Economist at the Pacific Forestry Centre of Forestry Canada, and Dr. David Haley, head of the Forest Management Department of the Faculty of Forestry at the University of British Columbia, are responsible for initiating funding and providing the institutional support for this workshop. Their personal commitment to improving communication and the quality of analysis in silviculture economics lead to the development of the workshop.

Several members of the Forest Management Department of the Faculty of Forestry at UBC devoted time, energy and expertise to this project. Dr. Peter Marshall assisted with the design and content of the workshop. Dr. Marshall and Ron Turner arranged the computer facilities and dealt with the inevitable "computer glitches." Their assistance in this area is greatly appreciated. Sally Wong handled the typing, copying and clerical tasks admirably, despite the short deadlines.

The effectiveness of the workshop was due in large part to the people who moderated specific sessions, namely Dr. Marshall, Gary Townsend of the B.C. Forest Service, and Dr. Casey van Kooten from UBC. Their volunteer contributions are very much appreciated.

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Workshop Coordinator

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BACKGROUND

Research and development in computer-based models for allocating resources in silviculture programs is under way at the University of British Columbia in the Faculty of Forestry and the Forest Economics and Policy Analysis Unit (FEPA), as well as at several locations of Forestry Canada and the B.C. Ministry of Forests. These models range from regional simulation models and forest level optimization tools, to stand level spreadsheet calculators.

Analysts in this field face complex conceptual and analytical problems. Although they would benefit greatly from exchanges of ideas and information, there have been few opportunities for interactions of this kind. Neither have there been many opportunities for decision-makers and potential users of these models to provide feedback to analysts about their needs and the utility of the various tools being developed.

To encourage and facilitate this type of communication, the Economics Section of the Pacific Forestry Centre of Forestry Canada and the Forest Management Department of the Faculty of Forestry at the University of British Columbia jointly funded and organized a workshop on November 6 and 7, 1990, at the University Golf Club in Vancouver.

WORKSHOP OBJECTIVES

The objectives of this workshop were threefold:

1. to familiarize both the modellers and the client group representatives who are responsible for facilitating research in this field and being liaisons between modellers and decision-makers;
2. to facilitate exchange of information and ideas amongst these individuals;
3. to encourage continued discussions amongst the participants.

WORKSHOP FORMAT

Personal invitations were sent to analysts who were actively involved in the development of computerized silviculture decision models, and to representatives of client groups who are responsible for facilitating research in this field and liaising between modellers and decision-makers. Each analyst was asked to complete a data sheet describing his model, and to make a short presentation during the workshop.

The 2-day workshop was structured around sessions on stand, forest and regional/provincial level models. Each session began with small group discussions to identify the desired characteristics, or a "wish list," for each category of models. This was followed by short presentations on the models in each category (see Table 1). Each session ended with a group discussion of the problems and opportunities in the various model categories.

The participants then identified a list of "unanswered questions" and broke into small groups to discuss the most pressing issues. The workshop ended with a review of the groups' discussions and identification of the priorities for future work.

Throughout the workshop the participants were encouraged to become familiar with existing programs by testing them on computers available in the adjacent room. Ample time was provided during the breaks, lunches and a social hour before dinner to encourage hands-on testing.

The agenda for the workshop is included in Appendix 1.

TABLE 1. Silviculture decision models reviewed during the workshop

Model category	Model name	Sponsoring organization
Stand level	SYLVER	Research Branch, B.C. Forest Service
	SDSS	McDaniels Research Ltd., Vancouver
	FIDME PC	Forestry Canada, Ontario Region
	E-XENO	MacMillan Bloedel Ltd.
	FINSIL3	MacMillan Bloedel Ltd.
	FRIEND	T.M. Thomson and Associates Ltd.
Forest level	FORPLAN	UBC
	MUSYC	Integrated Resources Branch, B.C. Forest Service
	PC-MUSYC	Forestry Canada, Pacific Forestry Centre
	SDSS	McDaniels Research Ltd., Vancouver
	PLANTS	UBC
	TRIM	Reid, Collins and Associates Ltd.
	FIBREPLAN	T.M. Thomson and Associates Ltd.
	IFS-YIELD	Industrial Forestry Services Ltd.
Regional/provincial level	B.C. Silviculture Planning Model	FEPA
	Weighted Goal Spreadsheet	Silviculture Branch, B.C. Forest Service

PARTICIPATION

The organizers were very pleased with the interest in this workshop; most of the invitees attended, and many other individuals asked to participate. Table 2 summarizes the affiliation of the 32 participants.

TABLE 2. Affiliation of the workshop participants

Affiliation	Number of participants
B.C. Forest Service	9
Forestry Canada	5
UBC	9
Forest companies	3
Consultants	6

Appendix 2 contains the names, addresses and phone and facsimile numbers for the workshop participants, as well as a list of individuals who were invited but did not attend the workshop.

SUMMARY OF DISCUSSIONS

Appendix 3 contains the datasheets on the decision models that were described during the formal presentations. Appendix 4 contains a detailed listing of the points raised during the group discussions. The following is a summary of these points.

Desired Characteristics of Silviculture Decision Models

Stand level models

Design factors were the focus of the discussion on the desired characteristics of stand level models. The major points were:

- the need to have linkages between growth projection systems, stand models and forest level models;
- the importance of defining the context, objectives and decision criteria for various types of analyses;
- the need to represent the structure of silviculture decisions adequately, including the sequential timing of treatments and the large number of possible treatment combinations;
- the need to include an explicit treatment of uncertainty; and
- the need to provide for customizing a program.

The importance of using local data at the appropriate level of detail was also stressed. As well, many participants called for simple, efficient, "battle-ready" programs which can be easily used by operational decision-makers.

While the existing stand level models were seen to have many potential applications, their current use was felt to be limited by the following factors:

- lack of an overall planning structure,
- lack of credible data,
- low technical knowledge amongst users,
- lack of awareness amongst potential users of what is available and what each program is designed to do, and
- lack of communication amongst modellers, operational decision-makers and the data sources.

Forest level models

Again the discussion focused on design factors with linkages to other levels of analysis, and on the need to define the objectives and assumptions. Other desirable design factors included the need for the models to:

- mimic how forests are actually harvested, including spatial distribution, species mix and product quality,
- account for impacts on non-timber resources,
- include a long planning horizon (greater than one rotation),
- provide detail of input and output representative of time horizon and level of precision in the data; and
- provide opportunities for sensitivity analysis.

There was a great deal of concern about the impact of aggregation on the precision of the data bases, and about the need for geographically referenced data. The user interface should be easy to access and check and the programs should be accessible to operational planners. Outputs should include timber supply information and reports on the required activities.

The group discussion on the current use of forest level models focused on their weaknesses, including:

- limited attention to non-timber resources,
- limited linkage with geographic information systems,
- lack of sensitivity to the needs of the planners and the variety of possible applications.

Further work is needed to test the impacts of yield analysis constraints and long- versus short-term analyses on the results, and to reconcile the common planning level objectives (e.g., to maintain wood supply) and constraints (e.g., declining even flow).

Regional/Provincial models

In contrast to the previous categories, the discussion on the desired characteristics of regional/ provincial models was entirely centred on design factors. No comments were made about data bases or the user interface.

The need to develop linkages between the levels of analysis and to define objectives was stressed again. The additional design issues at this level included:

- the need for a focus on strategic planning to provide broad guidelines that can be implemented at the operational level;
- the need for multi-sector regional analysis (input-output structure) to address diversification yet assess tradeoffs between regions and sectors;
- the need for planning horizons that are 5 years, with additional long-term outlooks.

Several obstacles to developing and implementing regional/provincial models were also identified:

- a current process that is budget and management goal driven, with no emphasis on planning
- the lack of a long-term perspective
- the impacts of the political process
- the lack of long-term funding and commitment.

THE UNANSWERED QUESTIONS

Ten unanswered questions were identified by the participants after their review and discussions of the various models. These questions were aggregated into four core issues. The comments from the groups who addressed each issue are summarized below. The priorities for improvement are summarized in the next section.

1. ***What is the importance of silviculture relative to other programs (including non-forest resources and other timber oriented programs)?***

   Participants agreed that all forest management activities, not just silviculture, should be evaluated using a similar process so that tradeoffs between activities can be assessed. There has been a tendency to neglect the non-timber values in most analyses, but this is not acceptable. It is especially important to evaluate the importance of preserving options for future flexibility.

2. ***How do we develop a framework of models and link their objectives and data bases?***

   The issue of whether to create separate models to address each objective or level of the decision, or a single model to address all decisions (a supermodel), was discussed. Most participants favoured a network of models. The opportunity now exists to design a framework with the existing models, improving the linkages between them. It is particularly important to co-ordinate the output from one model with the input requirements of the models at the adjacent levels in the framework. This should improve the accuracy of analyses and reduce the present redundancy in data collection and aggregation.

   The outputs of this framework should be quantitative and qualitative, but they must also satisfy the decision-makers and be adequately robust. To achieve these objectives there must be a commitment to long-term development and implementation of this framework. Resources should be identified to ensure continuity and flexibility in the development, evolution and retirement of models. All parties should recognize that this will be a continuously developing process.

   The process should also be forward looking. Flexibility will be needed to handle the uncertainties of future developments.

3. ***How do we improve the data bases?***

The use of each model should establish the data required. Issues such as the need for fundamental versus empirical data and the critical range of the data should be evaluated in the context of the structure of the model in which the data will be used. The effect of availability of data on treatment costs, establishment success rates, stand dynamics, and labour impacts needs to be addressed. In general, the broader concerns rather than specific issues related to data availability should be examined.

4. ***How do we encourage decision-makers to use the existing models?***

There was widespread agreement about the lack of communication between modellers and decision-makers. Several suggestions about why this has occurred were made: model development has been carried out in agencies and academic institutions where there is little connection with operational decision-makers; a fundamental communications gap exists because the modelling/economics culture excludes "right-brain thinking" people; modellers and the models they create do not recognize the institutional environment in which decision-makers must operate; and few models have been developed with direct user involvement. The productivity of the consultant/client relationship was also questioned. Although the relationship promotes communication, significant compromises in the design of the model may result in the interests of time saving or money.

It was also recognized that decision-makers generally have had few incentives to improve the quality of their decisions because of the lack of accountability for these decisions within most organizations. This will change as external program auditing is increased and public scrutiny expands.

Improved communications between these groups will require a commitment from both parties.

PRIORITIES FOR IMPROVEMENT

Co-ordination

An independent agency is needed to act as a clearing-house for information and to provide communication and co-ordination amongst modellers and decision-makers. Given that this is a national issue, it was suggested that Forestry Canada or an agency supported nationally should fill this role. The importance of including the users in this function to ensure involvement "from the bottom up" was stressed.

Improved communication

Further workshops to promote the sharing of information amongst modellers is needed. Equally important is the need to improve communications and contact between modellers and potential model users. This could be accomplished through "travelling workshops," delivered throughout the country. Free-ranging discussions of what is needed and how analyses might be done should be encouraged. Adaptive management strategies should be followed. The process used at FEPA to develop and design the B.C. Silviculture Model was cited as an example.

Designing a framework

Advisory groups of users should be struck to guide the design and development of a framework of models that address the various levels of this problem. An inventory of available models describing their applications should be created to identify which models might be applied within the framework and, more importantly, where gaps exist. It was suggested that new initiatives in model development not be publicly funded until this process is completed.

It is important that the framework provide users with opportunities to challenge the current timber bias of most existing analyses, and to test the tradeoffs between alternative activities (including timber versus non-timber forest resources and forestry versus other land uses).

The funding agencies and participants in this process must recognize that this framework will not be static. Frequent updating will be required as land management objectives change, analytical techniques and computer hardware develop, and the level of knowledge increases. Flexibility should be an explicit consideration in the design of both the process and the framework.

Designing new models

Development of new models should only be publicly supported if the models will play a role within the framework. Participants agreed that there are already a good number of models available without a "home" or user. This is especially true of stand level calculators. There appears to be little need for new models at this level; rather, new initiatives will focus on the forest and regional analysis levels.

Advisory groups of users should be created to guide and possibly support the development and implementation of new models. This is necessary to avoid the current situation in which model development has occurred without a committed set of users.

Data bases

Significant improvements could be made in the availability and quality of data bases for silviculture decision analyses if the following projects were immediately implemented:

- evaluation of the available information, including its format, quality and accessibility
- creation of an inventory of credible data bases.

The following projects should be initiated once the framework has been designed and the data requirements for each type of analyses are better understood:

- identification of data gaps and initiation of studies on the value of improved information
- improvement of linkages between data bases where appropriate.

APPENDIX 1: Agenda

WORKSHOP ON COMPUTER-BASED MODELS
FOR THE ALLOCATION OF RESOURCES TO SILVICULTURE

November 7 and 8, 1990
at the University Golf Club
5185 University Blvd., Vancouver, B.C.

Sponsored by Forestry Canada, Pacific Forestry Centre and the Department of Forest Resources Management, University of British Columbia

WEDNESDAY, November 7

08:30 **Opening Comments**

David Haley
Faculty of Forestry, UBC

Glenn Manning
Forestry Canada,
Pacific Forestry Centre, Victoria

08:40 **Introduction of Participants**

09:00 **Decision Making at the Stand Level**
Moderator: **Peter Marshall**, Faculty of Forestry, UBC

Desired Attributes of Stand Level Models
Small Group Discussions

09:45 **Break**

10:00 *Description of Stand Level Models*

SYLVER	**Ken Mitchell**, Research Branch, B.C. Ministry of Forests, Victoria
SDSS	**Cary Swoveland**, Quantalytics Inc., Vancouver
FIDME PC	**Bijan Payandeh**, Forestry Canada, Ontario Region, Sault Ste. Marie

11:00 **Break**

11:15 *More Stand Level Models*

E-XENO	**Peter Kofoed**, MacMillan Bloedel Ltd., Nanaimo
FINSIL3	**Peter Kofoed**, MacMillan Bloedel Ltd., Nanaimo
FRIEND	**Peter Affleck**, T.M. Thomson and Assoc., Victoria

11:45 **Lunch and Model Demonstrations**

1:15 *Application of Dynamic Programming to Stand Level Decisions*
Bill White, Forestry Canada, Northern Forestry Centre., Edmonton

Stand Level Modelling Problems and Opportunities
General Discussion

2:05 **Decision Making at the Forest Level**
Moderator: **Gary Townsend**, Industry Development Branch, B.C. Ministry of Forests, Victoria

Desired Attributes of Forest Level Models
Small Group Discussions

3:00 **Break**

3:15 *Descriptions of Forest Level Models*

FORPLAN	**John Nelson**, Faculty of Forestry, UBC
MUSYC	**Dave Waddell**, Integrated Resources Branch, B.C. Ministry of Forests, Victoria, and **Dan Petersen**, Pacific Forestry Centre, Victoria
SDSS	**Cary Swoveland**, Quantalytics Inc., Vancouver
PLANTS	**Jordy Tanz**, Faculty of Forestry, UBC

4:35 *Model Demonstrations and* ***No-host Bar***

7:00 **Dinner**

Speaker: Dean **Clark S. Binkley**
Faculty of Forestry, UBC

THURSDAY, November 8

07:30 *Model Demonstrations*
Coffee and muffins

08:30 *More Forest Level Models*

TRIM	**John Hammons**, Reid, Collins & Associates Ltd., Vancouver
FIBREPLAN	**Peter Affleck**, T.M. Thomson Ltd., Victoria
IFS-YIELD	**John Pousette**, Industrial Forestry Services Ltd., Prince George

Forest Level Modelling Problems and Opportunities
General Discussion

09:35 **Break**

09:50 **Decision Making at the Regional (Provincial) Level**
Moderator: **Casey van Kooten**, Faculties of Agriculture & Forestry, UBC
Desired Characteristics of Regional Analyses
Small Group Discussions
Description of Regional Models
B.C. SILVICULTURAL PLANNING MODEL
Bill Thompson, FEPA Project, UBC
WEIGHTED GOAL SPREADSHEET
Cindy Pearce for Silviculture Branch, B.C. Ministry of Forests, Victoria
Regional Level Modelling Problems and Opportunities
General Discussion

11:35 *Model Demonstrations*

12:00 **Lunch**

1:00 **The Unanswered Questions**
Small Group Discussions
Moderator: **David Haley**, Faculty of Forestry, UBC
Where to from here: The Priorities
Group Discussion

2:50 **Closing Remarks**

David Haley
Faculty of Forestry, UBC
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3:00 Adjourn

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APPENDIX 3: Silviculture decision model information

Stand Level Models

SILVICULTURE DECISION MODEL INFORMATION

Model Name SYLVER - FAN$Y

General Description

Perspective: ☒ stand ☐ forest ☐ regional ☐ other _____

Expected users: Silviculturists, planners (forest & mill)

Expected applications: Evaluate relative merits of silvicultural practices; alternative products (logs/lumber), lumber grading methods, etc.

Computing Specifications

Operating environment: ☒ IBM ☐ Macintosh ☐ other _____

Preferred hardware specifications: SYLVER: 386 micro with colour VGA monitor. FAN$Y (financial module of SYLVER): 286 micro with monochrome monitor.

Language: C, FORTRAN, TRUEBASIC

Modelling approach: ☐ linear program ☐ dynamic program ☐ decision tree ☒ simulation ☐ spreadsheet ☐ other _____

Model Description *(attach additional pages if necessary)*

Input data required: SYLVER: stand description at age 0 (species, site, spatial distribution of trees, silvicultural treatments, etc.) FAN$Y: product files from SYLVER (logs, lumber, chips), costs, revenues, hauling distance, discount rate, etc. (default values are provided for all input data - approximately 100 variables)

Decision criteria: ☒ NPV ☒ IRR ☒ benefit/cost ratio ☐ profitability index ☐ other _____

Treatment of uncertainty: The stand growth model (TASS) in SYLVER contains stochastic variables. All other modules are deterministic.

Assumptions: Too numerous to list

Output information and format: FAN$Y: forestry & harvesting costs (itemized), manufacturing costs, taxes (itemized), log value by size & grade, chip value, lumber volume by size & grade, discounted revenues & costs, NPV, IRR, NPV/forestry costs ratio

Description of user interface: ☒ menu ☐ batch ☐ other _____

Status

Phase	Ongoing	Completed
Design		x
Programming		x
Testing	x	

Availability: FAN$Y: late 1990/early 1991 for version which simulates machine stress grading of lumber

Past or ongoing applications: Relative financial return from silvicultural treatments - espacement, pruning

Developer(s)

Name *Contact Person*	*Role*	*Address*	*Phone/Fax No.*
K. Mitchell	Design & Modelling	Forest Research Branch #506-1175 Douglas St. Victoria V8W 3E7	387-6673 387-8192(fax)
Collaborators			
R. Kellogg (retired)	Manager & Analyst	Forintek Canada Corp. 6620 N.W. Marine Dr. Vancouver V6T 1X2	922-0380
A. Folsson	Programmer	Killer Software Engineering 1143 Burnside Rd. Victoria V8Z 1N4	479-5870
D. Ormerod	Design & Programming	Sylvametrics Consulting 303-535 Yates St. Victoria V8W 1K7	361-3290

Additional Information

D. Coffey	Design & Financial Info.	Ministry of Forests Industry Development Branch 1450 Government St. Victoria V8W 3E7	387-8605

SILVICULTURE DECISION MODEL INFORMATION

Model Name E-XENO

General Description

Perspective: ☒ stand ☐ forest ☐ regional ☐ other _____

Expected users: Field Foresters, Analysts

Expected applications: Stand level decision making, input into forest level analysis, policy analysis.

Computing Specifications

Operating environment: ☒ IBM ☐ Macintosh ☐ other _____

Preferred hardware specifications: _____

Language: Microsoft Basic

Modelling approach: ☐ linear program ☐ dynamic program ☐ decision tree
☐ simulation ☐ spreadsheet ☐ other _____

Model Description *(attach additional pages if necessary)*

Input data required: (See Attached) Designed specifically to read files produced by the yield model Y-XENO (produces yield & other financial information). May input other yield tables at a more general information level.

Decision criteria: ☒ NPV ☒ IRR ☒ benefit/cost ratio ☐ profitability index
☐ other net revenue/treatment cost ratio

Treatment of uncertainty: None explicitly

Assumptions: _____

Output information and format: Range of tables from summary of incremental results to option and harvest detail.

Description of user interface: ☒ menu ☐ batch ☐ other _____

Status

Phase	Ongoing	Completed
Design		x
Programming		x
Testing		x

Availability: Is available as part of XENO package purchase.

Past or ongoing applications: Used by some field foresters for examining spacing opportunities. Used to assist with developing forest management guidelines.

Developer(s)

Name / *Contact Person*	*Role*	*Address*	*Phone/Fax No.*
Peter Kofoed	Developer	MacMillan Bloedel Ltd c/o 65 Front St. Nanaimo, B.C. V9R 5H9	755-3450 755-3550(fax)
Collaborators			
Steven Northway	Developer of Y-XENO	above	755-3484
D.L. Handley	Manager	above	

Additional Information

E-XENO is part of the XENO family - most useful if applied in conjunction with Y-XENO.
Ongoing improvements.

E-XENO Input Includes:

- Yield and financial information from files produced by Y-XENO
  - Stems per hectare, volume, gross value and stump to truck costs by species
  - Treatment costs.
- Selection of harvest cost and value options.
- Discount rate.
- Selection of Y-XENO files to read in
  - Growth delay and harvest range for each file.

E-XENO Output Includes:

- Incremental analysis results of up to 9 options compared to a base situation.
- For the base situation and each option — optional output includes:
  - Summary of harvest results
  - Cash flow summary
  - Final harvest details (by species)
  - Thinning harvest details
  - Comparison of rotation lengths.

SILVICULTURE DECISION MODEL INFORMATION

Model Name FINSIL3

General Description

Perspective: ☒ stand ☐ forest ☐ regional ☐ other _____

Expected users: a) students, b) silvicultural decision makers

Expected applications: a) assist teaching basic economics, b) provide ideas for others to develop appropriate template.

Computing Specifications

Operating environment: ☒ IBM ☐ Macintosh ☐ other _____

Preferred hardware specifications: _____

Language: Lotus 1-2-3

Modelling approach: ☐ linear program ☐ dynamic program ☐ decision tree ☐ simulation ☒ spreadsheet ☐ other _____

Model Description *(attach additional pages if necessary)*

Input data required: See Attached

Decision criteria: ☒ NPV ☐ IRR ☒ benefit/cost ratio ☐ profitability index ☐ other _____ net revenue/treatment cost ratio

Treatment of uncertainty: None

Assumptions: _____

Output information and format: Detail by option and harvest age. Cashflows, NPV, revenue/cost ratios for selected ages for incremental analysis of options compared to base.

Description of user interface: ☐ menu ☐ batch ☒ other use menus to move around spreadsheet.

Status

Phase	Ongoing	Completed
Design		x
Programming		x
Testing		x

Availability: Has undergone some changes - more to come. Identify version by date. Public domain software.

Past or ongoing applications: Primarily to assist teaching basics of silvicultural decision making.

Developer(s)

Name *Contact Person*	*Role*	*Address*	*Phone/Fax No.*
Peter Kofoed	Developer	Macmillan Bloedel Ltd c/o 65 Front St. Nanaimo, B.C. V9R 5n9	755-3450 755-3550(fax)

Collaborators

Additional Information

General Description of FINSIL3

- Examines the incremental value of silvicultural investment; that is the difference between with the investment and without the investment (e.g., for spacing it is the difference between the spaced stand and the unspaced stand).
- Can handle up to 5 treatment options at once comparing all to a base (untreated situation).
- For each option and the base FINSIL3 can examine up to 5 different harvest ages at the same time. Unless instructed otherwise it selects a financial rotation length (maximum discounted net value) for use in the incremental analysis.
- Results are presented for:
  - the current rotation
  - a perpetual series of rotations.
- Real price and cost trends may be applied for the "current rotation" analysis.
- Net harvest values depend on value and cost schedules related to average stand DBH.

  Harvest cost table available in FINSIL3 are based on those developed by Nawitka Resource Consultants and published in FRDA Report 014.

  Price tables are based on data presented by Sterling Wood Group Inc. in FRDA Report 041.

  The user may input his/her own schedules. The user selects the appropriate schedules and inputs transport distance.
- Other user input includes:
  - discount rate
  - real price and cost trends
  - annual costs
  - treatments — year, type and $/ha for each option and the base
  - from yield table output year, volume (m^3) and average DBH for up to 5 harvests for each option and the base situation.

SILVICULTURE DECISION MODEL INFORMATION

Model Name FIDME PC

General Description

Perspective: ☒ stand ☒ forest ☐ regional ☐ other _____

Expected users: Forest managers, silviculturists, forestry consultants

Expected applications: Forest Investment Decisions Made Easy on Personal Computers (FIDME PC)

Computing Specifications

Operating environment: ☒ IBM ☐ Macintosh ☐ other _____

Preferred hardware specifications: _____

Language: Turbo Pascal

Modelling approach: ☐ linear program ☐ dynamic program ☐ decision tree
☒ simulation ☐ spreadsheet ☐ other _____

Model Description *(attach additional pages if necessary)*

Input data required: Data may be entered interactively or from a file. It also allows reading a file and editing it before analysis. Three types of input are possible: point estimate, interval estimates and subjective probability estimates.

Decision criteria: ☒ NPV ☒ IRR ☒ benefit/cost ratio ☐ profitability index
☒ other cost-effectiveness

Treatment of uncertainty: Subjective estimate inputs to: a) provide a built in measure for risk and uncertainty, b) provide a method of augmenting data with personal judgement and c) incorporate variability and

Assumptions: associated probability with the output: Uses Weibull distribution to generate subjective probability distribution.

Output information and format: Both tabular and graphical output of the resulting distributions in addition to tabular summary of the input estimates.

Description of user interface: ☒ menu ☐ batch ☐ other creates editable input files.

Status

Phase	Ongoing	Completed
Design		x
Programming		x
Testing		x

Availability: It is available free of charge from Forestry Canada, Ontario Region

Past or ongoing applications: Distributed to 100+ users mainly with governmental agencies, universities, and private consultants. Is being used as a teaching tool at 2-4 forestry institutes.

Developer(s)

Name *Contact Person*	*Role*	*Address*	*Phone/Fax No.*
B. Payandeh	Designer	Forestry Canada Ontario Region P.O. Box 490 Sault Ste Marie, Ontario P6A 5M7	(705) 949-9461 (705) 759-5700(fax)
Collaborators			
D.T. Basham	Programmer	As above	

Additional Information

SILVICULTURE DECISION MODEL INFORMATION

Model Name rhIEND

General Description

Perspective: ☒ stand ☒ forest ☐ regional ☐ other _____

Expected users: Operational silviculturalists, Planners, Managers

Expected applications: Stand level prescriptions, estate planning, budgeting, management regime planning.

Computing Specifications

Operating environment: ☒ IBM ☐ Macintosh ☐ other _____

Preferred hardware specifications: PC (preferably 286/386) 40 Mg Hard Drive 640 k RAM

Language: DBase IV

Modelling approach: ☐ linear program ☐ dynamic program ☐ decision tree ☒ simulation ☐ spreadsheet ☒ other relational data bases

Model Description *(attach additional pages if necessary)*

Input data required: Yield tables, interest rates, treatment regimes, costs, revenues

Decision criteria: ☒ NPV ☒ IRR ☒ benefit/cost ratio ☐ profitability index ☐ other _____

Treatment of uncertainty: User validated input, sensitivity analysis from deterministic simulation model.

Assumptions: Specified by user.

Output information and format: Treatment options, cost, NPV, B/C; forest level planning information.

Description of user interface: ☒ menu ☐ batch ☐ other _____

Status

Phase	Ongoing	Completed
Design		x
Programming		x
Testing		x

Availability: Upon request

Past or ongoing applications: Industry & MoF in B.C. and Alta.

Developer(s)

Name *Contact Person*	*Role*	*Address*	*Phone/Fax No.*
Peter Affleck	Manager	Fortrends Consulting 1006 Government St. Victoria, B.C.	385-4468 385-1442

Collaborators

Additional Information

SILVICULTURE DECISION MODEL INFORMATION

Model Name TIMRET (TIMber RETurns)

General Description

Perspective: ☒ stand ☐ forest ☐ regional ☐ other (with potential extensions to forest)

Expected users: Analysts and forest managers with for. industry and prov. gov.

Expected applications: Profitibility analysis of silvicultural investments

Computing Specifications

Operating environment: ☒ IBM ☐ Macintosh ☐ other

Preferred hardware specifications:

Language: Quick Basic

Modelling approach: ☒ linear program ☐ dynamic program ☐ decision tree ☐ simulation ☐ spreadsheet ☐ other

Model Description *(attach additional pages if necessary)*

Input data required: treatment costs (forest renewal costs) and benefits, such as market value of increased yield, log size premiums, logging cost reductions and where applicable, products from trees removed by treatment

Decision criteria: ☒ NPV ☒ IRR ☒ benefit/cost ratio ☒ profitability index ☐ other

Treatment of uncertainty: None

Assumptions:

Output information and format: NPV, IRR, B/C ratio, profitibility index for six real or nominal discount rates are displayed on the screen and can be printed.

Description of user interface: ☒ menu ☐ batch ☐ other

Status

Phase	Ongoing	Completed
Design	x	x
Programming		x
Testing		x

Availability: Immediate: with a manual and diskette

Past or ongoing applications: Profitibility analysis of white spruce released from aspen in Manitoba and Saskatchewan: lodgepole pine thinning in Alberta.

Developer(s)

Name *Contact Person*	*Role*	*Address*	*Phone/Fax No.*
Bill Ondro	Economic design	Forestry Canada 5320 - 122 Street Edmonton, Alberta T5H 3S5	(403) 435-7245 (403) 435-7359 (fax)
Collaborators			
Ralph Mair	Computer program design	(as above)	(403) 435-7344 (403) 435-7359 (fax)

Additional Information

Manuscript to be submitted for journal publication soon.

SILVICULTURE DECISION MODEL INFORMATION

Model Name QUICKSILVER

General Description

Perspective: ☒ stand ☐ forest ☐ regional ☐ other _____

Expected users: Forest managers, silviculturalists

Expected applications: Silvicultural investment decisions at the stand level.

Computing Specifications

Operating environment: ☒ IBM ☐ Macintosh ☐ other _____

Preferred hardware specifications: _____

Language: MS-BASIC

Modelling approach: ☐ linear program ☐ dynamic program ☐ decision tree ☐ simulation ☐ spreadsheet ☐ other Simple calculator for financial analysis.

Model Description *(attach additional pages if necessary)*

Input data required: Transactions (managerial operations); transaction values (revenues and costs); timing of transactions; economic parameters (discount rate, inflation rate, tax options).

Decision criteria: ☒ NPV ☒ IRR ☒ benefit/cost ratio ☐ profitability index ☐ other annualized ROR, composite ROR.

Treatment of uncertainty: Sensitivity analysis; simple to change inputs and economic parameters.

Assumptions: _____

Output information and format: Tables of financial indices, cash flows, replacement costs, operating statement.

Description of user interface: ☒ menu ☒ batch ☐ other _____

Status

Phase	Ongoing	Completed
Design		X
Programming		X
Testing		X

Availability: Public domain.

Past or ongoing applications: Mainly used by private landowners in U.S., converted to metric units and used by MNR in Ontario. Teaching purposes.

Developer(s)

Name *Contact Person*	*Role*	*Address*	*Phone/Fax No.*

Collaborators

Additional Information

Originally developed by J.M. Vasiewich and Ronald Frebis at the USDA Forest Services S.E. Forest Experiment Station. Modified in Canada to metric units and Canadian tax system. A simple but rather cumbersome tool. Given its simplicity and clarity of output, it is useful for teaching and demonstration purposes.

Forest Level Models

SILVICULTURE DECISION MODEL INFORMATION

Model Name SDSS (Silviculture Decision Support System)

General Description

Perspective: ☒ stand ☒ forest ☐ regional ☐ other _____

Expected users: Silviculturalists, and planners

Expected applications: Silviculture prescriptions, forest planning & budgeting, policy analysis

Computing Specifications

Operating environment: ☒ IBM ☐ Macintosh ☐ other _____

Preferred hardware specifications: 80386/80387 or 80486

Language: C, LP code (XMP) is in FORTRAN

Modelling approach: ☒ linear program ☐ dynamic program ☒ decision tree
☐ simulation ☐ spreadsheet ☐ other _____

Model Description *(attach additional pages if necessary)*

Input data required: Inventory data, growth tables (volume & diameter), silviculture treatment costs and employment effects, silviculture treatment options and probability distributions of treatment outcomes, product prices and recovery factors, harvesting and processing costs, discount rates, objective criteria weights, and harvest scheduling constraints.

Decision criteria: ☐ NPV ☐ IRR ☐ benefit/cost ratio ☐ profitability index
☒ other User-specified weighted average of NPV's of net benefits (financial, employment generation &/or wood supply)

Treatment of uncertainty: Probabilities planned treatments are carried out; probabilities of site prep success; distribution of stocking after planting or natural regen & brushing

Assumptions: Main assumption is that present values of stands subjected to silviculture treatments can be estimated from post-optimality analysis of harvest scheduling LP model.

Output information and format: Optimal treatment policy is displayed as sequence of nested, windowed screens. Optimal values for each inventory unit are written to database and processed with database manager outside SDSS.

Description of user interface: ☒ menu ☐ batch ☐ other _____

Status

Phase	Ongoing	Completed
Design		x
Programming		x
Testing	x	

Availability: Contact Tim McDaniels at (604) 263-9615

Past or ongoing applications: Soon to be used to study silviculture program options in the Salmon Arm Forest District

Developer(s)

Name	*Role*	*Address*	*Phone/Fax No.*
Contact Person			
Tim McDaniels	Project Manager	McDaniels Research 310-2025 W. 42nd Ave Vancouver V6M 2B5	263-9615 266-3716 (fax)
Collaborators			
Cindy Pearce	Silviculturalist	2-1880 W. 19th Ave. Vancouver V6J 2N9	732-6169 732-9836 (fax)
Gary Swoveland	Systems design & programming	Quantalytics, Inc. 310-2025 W. 42nd Ave Vancouver V6M 2B5	266-1818 266-3716 (fax)

Additional Information SDSS uses decision trees to identify optimal silviculture treatment policies. The decision trees reflect both uncertainty over treatment outcomes and the sequential nature of silviculture treatments, from site preparation through stand tending activities. The decision trees may be quite large--up to a million end nodes--and one must be solved for each of several hundred distinct land types. Prior to solving the decision tree problems, the present values of stands subjected to alternative treatment regimes are estimated from post-optimality analyses of a sequence of linear programs.

SILVICULTURE DECISION MODEL INFORMATION

Model Name FORPLAN

General Description

Perspective: ☐ stand ☒ forest ☐ regional ☐ other _____

Expected users: Timber supply analysts

Expected applications: Timber supply analysis; Multiple resource allocation; evaluate region-wide silvicultural programs.

Computing Specifications

Operating environment: ☒ IBM ☐ Macintosh ☐ other _____

Preferred hardware specifications: 386, Math coprocessor, 4MB RAM

Language: FORTRAN

Modelling approach: ☒ linear program ☐ dynamic program ☐ decision tree
☐ simulation ☐ spreadsheet ☐ other _____

Model Description *(attach additional pages if necessary)*

Input data required: -Yield tables
- Data file specifying stands, objective function, costs, revenues, and constraints

Decision criteria: ☒ NPV ☐ IRR ☐ benefit/cost ratio ☐ profitability index
☐ other _____

Treatment of uncertainty: Model II formulation allows for stand transition probabilities eg. hardwoods, mortality, fire, etc.

Assumptions: 1) everything is linear, 2) everything known with certainty, 3) decision variables are divisible, 4) there are no joint effects... the whole is equal to the sum of the parts.

Output information and format: Wide choice of optimal reports and graphs

Description of user interface: ☒ menu ☐ batch ☒ other A menu to help run the model, but not to build the data.

Status

Phase	Ongoing	Completed
Design		x
Programming		x
Testing		x

Availability: Commercially available

Past or ongoing applications: Currently used by the USDA Forest Service and several universities.

Developer(s)

Name / *Contact Person*	*Role*	*Address*	*Phone/Fax No.*
USDA Forest Service		Land Management Planning Fort Collins, Colorado	
Collaborators Larry Davis, J. Keith Gilless		Dept. of Forestry & Resource Management 145 Mulford Hall University of California Berkely, CA 94720	(415)642-6489

Additional Information

The University of California, Berkely, is selling RM-FORPLAN for $500 U.S.. The LP package "LINDO" is available from the Scientific Press in San Francisco for $1,280 U.S.. The model is maintained by the USDA Forest Servide, and comes with a comprehensive manual.

SILVICULTURE DECISION MODEL INFORMATION

Model Name MUSYC

General Description

Perspective: ☐ stand ☒ forest ☐ regional ☐ other _____

Expected users: Ministry of Forests/Forestry Canada/ Forest Industry

Expected applications: Strategic timber harvest scheduling, long term forest management planning

Computing Specifications

Operating environment: ☒ IBM ☐ Macintosh ☒ other PC-DOS

Preferred hardware specifications: IBM 370 (mainframe)
PC: 4Mb RAM, 386 + LP Solution package

Language: FORTRAN

Modelling approach: ☒ linear program ☐ dynamic program ☐ decision tree
☐ simulation ☐ spreadsheet ☐ other _____

Model Description *(attach additional pages if necessary)*

Input data required:
model parameters, objectives, harvest constraints, cultural treatments & financial constraints, timber class data, subforest constraints, management alternatives, volume data, economic data

Decision criteria: ☒ NPV ☐ IRR ☐ benefit/cost ratio ☐ profitability index
☒ other maximize volume

Treatment of uncertainty: sensitivity analysis

Assumptions: user specified

Output information and format: harvest reports; economic reports; non-stocked reports; cultural treatment reports; inventory reports; inventory harvest and growth reports.

Description of user interface: ☐ menu ☒ batch ☐ other _____

Status

Phase	Ongoing	Completed
Design		x
Programming		x
Testing		x

Availability: 1979 IBM 370 version -Fortran source code

Past or ongoing applications: PC version/ IBM 370 version - Fortran 77 currently undergoing final testing.

Developer(s)

Name *Contact Person*	*Role*	*Address*	*Phone/Fax No.*
David Waddell	Systems Forester	Ministry of Forests 1450 Government St. Victoria, B.C. V8W 3E7	387-8383 387-6751(fax)
Collaborators			
Dan Peterson	Forest Economist	Forestry Canada 506 W. Burnside Victoria, B.C. V8Z 1M5	388-0615 388-0797(fax)

Additional Information

SILVICULTURE DECISION MODEL INFORMATION

Model Name PlanTS (Planning Timber Supply)

General Description

Perspective: ☐ stand ☒ forest ☐ regional ☐ other _____

Expected users: TSA/TFL planners, District-level silviculture planners

Expected applications: Development of forest management plans; development of silviculture programs

Computing Specifications

Operating environment: ☒ IBM ☐ Macintosh ☐ other _____

Preferred hardware specifications: EGA/VGA; math coprocessor; 640K RAM - hard disk drive with 1.5 meg free

Language: Pascal and FORTRAN

Modelling approach: ☐ linear program ☐ dynamic program ☐ decision tree
☒ simulation ☐ spreadsheet ☐ other _____

Model Description *(attach additional pages if necessary)*

Input data required: 1) Current forest description (age class, area, yield table for each existing stratum) 2) Response yields 3) Management activities planned (volume harvest, area treated)

Decision criteria: ☐ NPV ☐ IRR ☐ benefit/cost ratio ☐ profitability index
☒ other User's perspective on projected yield & cost flows

Treatment of uncertainty: Sensitivity analysis - PlanTS is strictly deterministic.

Assumptions: Similar to any strata-based, deterministic simulation.

Output information and format: Screen graphics, printed tables showing volumes harvested, areas treated, mortality, costs of harvest and treatment by period.

Description of user interface: ☒ menu ☐ batch ☐ other _____

Status

Phase	Ongoing	Completed
Design		
Programming		
Testing		

Availability: Available from UBC
-Demo version $100
-MoF owns a version which they have rights to distribute internally

Past or ongoing applications: MoF currently using their version in District offices.
-a new version, linking a short-term area-based model is currently under development.

Developer(s)

Name *Contact Person*	*Role*	*Address*	*Phone/Fax No.*
Rob Gasson	Research Analyst	UBC Faculty of Forestry Dept. Harv. & Wood Science	228-6592
Collaborators			
Dr. A.F. Howard	Asst. Prof.	UBC Forestry Harv. & Wood Science	228-3794
J.S. Tanz	Graduate Research Assistant	UBC Forestry Harv. & Wood Science	228-5177

Additional Information

SILVICULTURE DECISION MODEL INFORMATION

Model Name FIBRPLAN (Portrends Consulting)

General Description

Perspective: ☐ stand ☒ forest ☐ regional ☐ other _____

Expected users: Industry & Government & Educational Institutions

Expected applications: Forest management unit planning, land exchange, budgeting, silviculture planning, training.

Computing Specifications

Operating environment: ☒ IBM ☐ Macintosh ☐ other _____

Preferred hardware specifications: PC with 640K RAM 10 Mg HD

Language: Executable Code

Modelling approach: ☐ linear program ☐ dynamic program ☐ decision tree
☒ simulation ☐ spreadsheet ☐ other _____

Model Description *(attach additional pages if necessary)*

Input data required: Forest inventory, land base inventory, yield tables, management regimes, revenues*, costs*.

*optional

Decision criteria: ☐ NPV ☐ IRR ☐ benefit/cost ratio ☐ profitability index
☐ other _____

Treatment of uncertainty: N/A Deterministic simulation model. Handled through sensitivity analysis.

Assumptions: Specified by user.

Output information and format: Harvest profile, planning reports

Description of user interface: ☒ menu ☐ batch ☐ other _____

Status

Phase	Ongoing	Completed
Design		x
Programming		x
Testing		x

Availability: Upon order.

Past or ongoing applications: Forest level planning, land exchange training, silviculture planning.

Sold and used commercially for 5 years.

Developer(s)

Name *Contact Person*	*Role*	*Address*	*Phone/Fax No.*
Dr. D.B. Reimer	Manager	Fortrends Consulting 1006 Government Victoria, B.C. V8W 1X7	385-4468 385-1442(fax)

Collaborators

Additional Information

SILVICULTURE DECISION MODEL INFORMATION

Model Name IFSYIELD

General Description

Perspective: ☐ stand ☒ forest ☐ regional ☐ other _____

Expected users: Anyone interested in the forecasting of future timber supply

Expected applications: IFSYIELD ia a Forest Estate Model that can be used to test the effect of various alternative silvicultural strategies on future timber supplies.

Computing Specifications

Operating environment: ☐ IBM ☐ Macintosh ☒ other DEC VAX VMS

Preferred hardware specifications: DEC MICROVAX 3600

Language: FORTRAN

Modelling approach: ☐ linear program ☐ dynamic program ☐ decision tree
☒ simulation ☐ spreadsheet ☐ other _____

Model Description *(attach additional pages if necessary)*

Input data required: The project area is aggregated into analysis units (forest types with similar volume, diameter, height, growth and silvicultural characteristics). Input files consisting of area, NSR, volume, diameter, silvicultural assumptions, harvesting priorities and others are used in the model to determine harvest levels.

Decision criteria: ☐ NPV ☐ IRR ☐ benefit/cost ratio ☐ profitability index
☐ other N/A

Treatment of uncertainty: N/A

Assumptions: N/A

Output information and format: Tabular and graphic representation of: areas and volumes harvested (harvest forecast), inventory age class distribution by area, growing stock and trends in average age-diameter-vol/ha harvested.

Description of user interface: ☒ menu ☐ batch ☐ other _____
Interactive

Status

Phase	Ongoing	Completed
Design		x
Programming		x
Testing		x

Availability: Proprietary model

*In house use (VAX Environment)

or *Remote terminal with modem

Past or ongoing applications: A Timber supply model. The effect of various alternative silvicultural strategies on future timber supplies are frequently examined.

Developer(s)

Name	*Role*	*Address*	*Phone/Fax No.*
Contact Person			
John Pousette		Industrial Forestry Service Ltd. 1595 Fifth Avenue Prince George, B.C. V2L 3L9	Ph: 564-4115 Fax:563-9679
Collaborators			
Hans Mannhardt	programmer	Industrial Forestry Service Ltd.	

Additional Information

See attached brief description.

SILVICULTURE DECISION MODEL INFORMATION

Model Name TRIM

General Description

Perspective: ☐ stand ☒ forest ☒ regional ☐ other _____

Expected users: TFL Holders

Expected applications: TFL yield analysis for management and working plans- possibly TSA yield analysis

Computing Specifications

Operating environment: ☒ IBM ☐ Macintosh ☐ other VAX Mainframe

Preferred hardware specifications: AT with 20 meg. hard disk

Language: Fortran

Modelling approach: ☐ linear program ☐ dynamic program ☐ decision tree
☒ simulation ☐ spreadsheet ☐ other _____

Model Description *(attach additional pages if necessary)*

Input data required: Starting area & volume by age class for all growth types in inventory & yield tables for all growth types.

Decision criteria: ☐ NPV ☐ IRR ☐ benefit/cost ratio ☐ profitability index
☐ other None

Treatment of uncertainty: None

Assumptions: Volume is harvested by growth type proportional to the volume present in each growth type.

Output information and format: Table output

Description of user interface: ☐ menu ☒ batch ☐ other _____

Status

Phase	Ongoing	Completed
Design		
Programming		
Testing		

Availability: Two versions- PC TRIM & TRIM both available from U.S.F.S. Reid Collins has customised both versions for B.C. conditions.

Past or ongoing applications:

Developer(s)

Name *Contact Person*	*Role*	*Address*	*Phone/Fax No.*
John Hammons	Analyst	401 W. Georgia St. 10th Floor Vancouver, B.C. V6B 5A1	604 664-5433

Collaborators

Additional Information

Regional/Provincial Models

SILVICULTURE DECISION MODEL INFORMATION

Model Name Incremental Allocation Mechanism

General Description

Perspective: ☐ stand ☐ forest ☒ regional ☒ other provincial

Expected users: Regional Silviculture Officers & Stand Tending Foresters

Expected applications: Allocation of Budget goals to the six B.C. Forest Regions

Computing Specifications

Operating environment: ☒ IBM ☐ Macintosh ☐ other _____

Preferred hardware specifications: XT

Language: Lotus

Modelling approach: ☐ linear program ☐ dynamic program ☐ decision tree ☐ simulation ☒ spreadsheet ☐ other _____

Model Description *(attach additional pages if necessary)*

Input data required: Selection criteria: 1. Fall down (timing & extent), 2. Regional Needs (potential areas for treatment, Regional Goals/Accomplishments) 3. Population Dependency (on Forest Industry - labour, unemployment, regional economic growth, annual mill production, community stability), 4. Endowment Ratios (Regional land productivity potential, proportional of Provincial AAC supported by Regional AAC); criteria value for each region

Decision criteria: ☐ NPV ☐ IRR ☐ benefit/cost ratio ☐ profitability index ☒ other weighted objectives

Treatment of uncertainty: none

Assumptions: Criteria must be applicable to each Region

Output information and format: weighted percent budget allocations for each Region totalling to 100%.

Description of user interface: ☐ menu ☐ batch ☒ other spreadsheet

Status

Phase	Ongoing	Completed
Design	x	
Programming		
Testing		

Availability: on request; can develop your own quite easily.

Past or ongoing applications: Will be updated for MOF 5-year Plan and FRDA II (if and when)

Developer(s)

Name *Contact Person*	*Role*	*Address*	*Phone/Fax No.*
Frank Barber		Silviculture Branch	387-8910
Mike Wyeth		3rd Floor, 31 Bastion Sq.	387-1467 (fax)
		Victoria, B.C. V8W 3E7	

Collaborators

Additional Information

Once the criteria are weighted and the criteria data are ranked between regions the spreadsheet is fixed. The only input is the amount of $'s to be allocated.

SILVICULTURE DECISION MODEL INFORMATION

Model Name FOREST (B.C. Silvicultural Planning Model)

General Description

Perspective: ☐ stand ☐ forest ☒ regional ☐ other _____

Expected users: B.C. Ministry of Forests headquarters staff

Expected applications: Silvicultural budgeting; Silvicultural offset of AAC loss from land alienation

Computing Specifications

Operating environment: ☒ IBM ☐ Macintosh ☐ other _____

Preferred hardware specifications: 80386 with hard disk and math co-processor

Language: Microsoft Quick Basic

Modelling approach: ☐ linear program ☐ dynamic program ☐ decision tree
☒ simulation ☐ spreadsheet ☐ other _____

Model Description *(attach additional pages if necessary)*

Input data required: For each of 108 land classes & 16 age classes each: area, growth & yield, delivered wood cost, log value. Less detailed input for: stand operability; future trends in costs & log values; fire & insect pests; silvicultural costs, labour requirements, priorities & budgets; forest proection costs, priorities & budgets; stumpage rates, employment multipliers & economic operability limits; AAC by region.

Decision criteria: ☐ NPV ☐ IRR ☐ benefit/cost ratio ☐ profitability index
☒ other User selected, including NPV

Treatment of uncertainty: Sensitivity analysis

Assumptions: Simple forest estate model - details available from FEPA or Silviculture Branch of the B.C. Ministry of Forests

Output information and format: Include employment, stumpage, costs, revenues, inventory, losses to fire & insects, harvest area & volume, NSR area. Graphic output during simulation. Numeric output formatted for Lotus 1-2-3 spreadsheets (templates provided).

Description of user interface: ☒ menu ☐ batch ☐ other _____

Status

Phase	Ongoing	Completed
Design		X
Programming		X
Testing		X

Availability: Program and documentation from either Silviculture Branch, MoF, 31 Bastion Square, Victoria V8W 3E7 or FEPA Research Unit, U.B.C., Room 468, 2206 East Mall, Vancouver V6T 1Z8

Past or ongoing applications: Economic analysis of (a) NSR land rehabilitation; (b) incremental silviculture; (c) forest land alienation.

Developer(s)

Name *Contact Person*	*Role*	*Address*	*Phone/Fax No.*
William Thompson	Applications/ Programming	FEPA Research Unit, UBC #468 - 2206 East Mall Vancouver V6T 1Z8	228-3163 228-6970 (fax)
Collaborators			
Susan Phelps	Programming	FEPA Research Unit, UBC #468 - 2206 East Mall Vancouver V6T 1Z8	228-6187 228-6970 (fax)
David Tait	Design/ Programming	Faculty of Forestry UBC, MacMillan Building Vancouver V6T 1W5	228-5303 222-8645 (fax)
Tim Webb	Design/ Programming	ESSA 3rd Floor, 1765 W. 8th Vancouver V6J 5C6	733-2996 733-4657 (fax)

Additional Information

Other developers: Carl Walters, U.B.C.; Peter McNamee, ESSA.

We consider FOREST to be a prototype planning model. We hope that in both its strengths and weaknesses it will help people clarify the issues of how such a model should work, what data they should use, what linkages are required to other data bases or models, what problems it should help solve, and who should use it.

APPENDIX 4: Summary of comments

SUMMARY OF COMMENTS FROM THE SILVICULTURE DECISION MODELS WORKSHOP

STAND LEVEL MODELS

Desired Characteristics

Design

- tied to forest level analyses by linkages with yield models and forest level economics
- directly linked with biological and physiological treatment response information (growth projection systems)
- clear about the context of the analysis; options include integrated resource use issues, policy analyses, and operational analyses
- variety of objective functions
  - volume
  - value
- provide opportunity to explore objective functions and tradeoffs within the objective space
- decision criteria depend on the type of decision (i.e., budget allocation versus option selection); financial criteria should be included
- decision variables include
  - rotation length
  - treatment options (including planting and initial stand density)
  - species mixes
- analytical approach may be simulation (for regime analysis) or optimization (for budget allocation)
- represents the sequential pattern of management activities and allows analysis of a variety of treatment combinations
- uncertainty treated explicitly by either incorporating "expert" judgements or prompting sensitivity analysis
- allow for customization
- develop bench mark programs to allow comparisons
- peer reviewed

Data bases

- opportunity to calibrate data to represent local conditions
- effects of treatment on physical log size and log quality/grades represented
- include geo-referenced stand records
- the user should be able to select the level of detail in the data

Programming

- source code available to allow customization
- operates on a number of systems
- peer reviewed

User Interface

- simple, efficient, operational orientation, and friendly
- reliable "battle ready" product
- documented at several levels
- display/interface encourages use

Evaluation of the Current Use of Stand Level Models

Strengths

- can identify data gaps
- prompts operational people to evaluate decisions and test options
- provides process for budget rationalization

Weaknesses

- lack of an overall planning structure within which stand level models can be used
- lack of data
- feasible options are overlooked because they are not included in the analysis
- low technical knowledge amongst users
- lack of awareness of what is available, and poor information on which models do what
- lack of contact/communications amongst modellers, operational people, and data sources

FOREST LEVEL MODELS

Desired Characteristics

Design

- interfaces with stand models
  - growth and yield tables/curves (simulators)
  - optimization at the stand level?
  - volume versus value?
- clearly stated objectives and assumptions (objectives may include economic analysis with tracking of costs and revenues, developing strategic plans or allocating dollars between stands)
- mimic how forests are actually harvested
  - spatial component
  - species mix
  - quality
- account for impacts on non-timber resources
  - e.g., wildlife, visual
- greater than one rotation period is analyzed
- operational detail
  - less as time proceeds
  - short term versus long term
  - level of precision
- clear sensitivity component for inputs and outputs (simulators for sensitivity analysis, post-optimality)

Data bases

- impact of aggregation
- data precision
- reference to location
- incorporate biological and operational realities

User Interface

- easy to use and understand
- easy to check
- accessible to working planners
- reports timber supply (including location and volume to be harvested) and required activities

Evaluation of the Current Use of Forest Level Models

Weaknesses

- little attention to non-timber objectives (FORPLAN only)
- limited linkage with geographic data
- limited communication between inventory projections system and the forest projection system (is this an organization issue?)
- not sensitive to the needs of the planner and the variety of levels of use

Further work needed

- process to test impacts of yield analysis constraints
- impact of choosing short- versus long-term analysis
- reconciliation of planning level objectives and constraints

REGIONAL/PROVINCIAL MODELS

Desired Characteristics

Design

- the "dilemma" is strategic (global) versus tactical (local) planning; this level is strategic, not operational
- provide broad guidelines at the provincial level which can be translated into sub-guidelines (regional needs) addressed at the regional (forest) level and applied at the operational (stand) level
- multi-sector analysis is needed; diversification is most important
- objectives must be clearly defined; may be net social benefits, jobs, well-being (quality of life) or GDP
- must assess tradeoffs (jobs, etc.) in one region versus another
- optimization should be possible but there are many problems associated with it; simulation provides graphical outputs
- regional models preferred
- regional input/output model structure
- planning horizons approximately 5 years (or election cycle); also need long-term outlook

Obstacles

- current process is budget and management goal driven
- lack of long-term planning to achieve strategic goals
- lack of regional and intra-regional planning
- needs to be uncoupled from the political process
- lack of long-term funding allocation and commitment

THE UNANSWERED QUESTIONS

1. **What is the importance of silviculture relative to other programs (including non-forest resources and other timber oriented programs)?**

   Comments

   - need to evaluate all forest management activities, not just silviculture
   - tend to neglect non-timber forest values in most analyses
   - need to consider tradeoffs between activities
   - importance of preserving options (maximizing future flexibility)
   - when you assess what/how other provinces/countries do in this area, "muddling through" is frequent (e.g., in agriculture)

   Opportunities for Improvement

   - challenge the timber management bias
   - co-ordination is needed
     - should be initiated from the bottom up (from the districts)
     - need response functions ($ in = what outputs)

2. **How do we develop a framework of models and link their objectives and data bases?**

   Comments

   Objectives:

   - one model/objective versus complete model (supermodel)
   - objectives change and thus need flexibility

   Linkages:

   - clear opportunities for improvement
   - co-ordinate model output with input at the next level to improve accuracy and reduce redundancy
   - must know where data output is going and how it is being used

   Development:

   - output should be quantitative, qualitative, satisfying, and robust
   - longer term context needed
   - need commitment to implementation, not just to development
   - need to identify what is missing; thus, must take inventory of the available programs and identify their applications
   - must commit resources for continuity, flexibility, evolution and retirement of models

   Philosophy:

   - forward looking versus backward looking
   - need flexibility to handle uncertainty

Opportunities for Improvement

- create an independent agency to act as a clearing-house and to provide co-ordination
- hold workshops to promote sharing of information amongst modellers and between modellers and users
- identify gaps in available models and fill them

3. How do we improve the data bases?

Comments

- the objectives of the model (or use of information) should drive the priorities for collecting data
- is fundamental or empirical information needed?
- what information do we already have: form, quality, access?
- need to identify the critical portion of the range of data
- look beyond specific issues to broader concerns
- need more stand level data before attaching economic/ financial data
- need to get better data on treatment costs, establishment success rates, and labour

Remember: decisions have to be made: make the best of what is available.

Opportunities for Improvement

- evaluate available information
- create an inventory of data bases
- improve communications between data bases
- initiate studies on value of improved information

4. How do we encourage decision-makers to use the existing models?

Comments

- lack of communication between modellers and decision-makers
  - is the consultant/client relationship the most productive?
  - modelling/economics culture excludes right-brain thinking people
- models and modellers must recognize the institutional environment
- currently there is little accountability for operational decisions
  - auditing will improve accountability
  - public scrutiny will have an impact
- improvement will only come with commitment from both parties

Opportunities for Improvement

- travelling workshops to develop understanding of the process amongst decision-makers
  - follow adaptive management strategies (à la Carl Walters)
  - encourage free-ranging discussions of what is needed and how to do it
  - ESSA model development process is an example
- create advisory groups of users to guide the design and development of a framework and individual models
- recognize that a "continuous design process" exists